

ENDEMIC VASCULAR PLANTS OF NORTHWESTERN CALIFORNIA AND SOUTHWESTERN OREGON

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ABSTRACT

An account of the endemic vascular plants of northwestern California and southwestern Oregon is presented. This component of the California Floristic Province, known for its high species richness, was found to have a large number of neoendemics in a regional flora generally characterized as relictual in nature. A list of endemics provides distribution by county and formal designations of rarity and endangerment for 281 taxa in 42 families.

The flora of northwestern California and southwestern Oregon has long been known for its high floristic richness (Stebbins and Major 1965). We estimate that there are over 3500 taxa of vascular plants, in about 150 families and 760 genera, in northwestern California alone (Smith and Sawyer 1987). The region may be viewed as the last major frontier along the Pacific Coast to be studied in detail. Intensive collecting began only about 20 years ago, after the pioneering work of Alice Eastwood, Joseph P. Tracy, Thomas Jefferson Howell, Edward Greene, Milo Baker, and Doris Niles. Our work in the last two decades, along with our students and colleagues (Muth 1967, Ferlatte 1974, Oettinger 1975, Barker 1979, Nelson 1979, Stillman 1980, Whipple 1981), has resulted in a more detailed knowledge of this interesting flora. Recent efforts at determining the status of rare and endangered plants in both states also has added greatly to our knowledge (Siddall et al. 1979, Meinke 1981, Smith and York 1984, Soper et al. 1985, York 1985). We now have a good account of the endemic vascular flora of this region.

STUDY AREA

Northwestern California and southwestern Oregon, a region of about 55,000 km², are considered part of the California Floristic Province (Howell 1955, 1956, 1957, Noldenke and Howell 1960, Stebbins and Major 1965, Raven and Axelrod 1978). Therefore, for both floristic and geographic reasons, the plants endemic to southwestern Oregon also are included here. Whereas the Klamath Mountains and the North Coast Ranges represent only 15% of the area of the California Floristic Province, they include some 65% of the 4452 native taxa found growing in the province as a whole (Raven and Axelrod 1978). The floristic diversity here is exceptional.

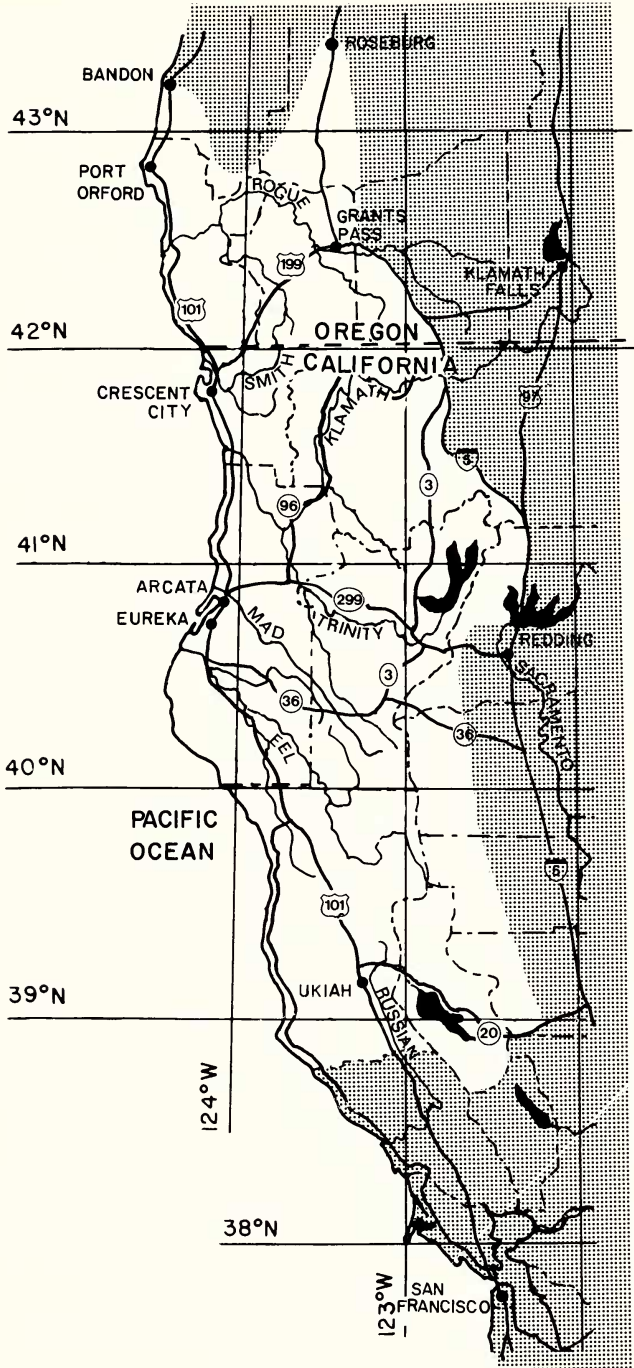


FIG. 1. Location of the study area in northwestern California and southwestern Oregon (shown in white).

The study area (Fig. 1) centers on the Klamath Mountains, a geologic province of ancient rocks and landforms (Irwin 1960, 1981). They constitute a poorly defined set of ranges, including the Eddies, Marbles, Salmons, Scott Bars, Scotts, Siskiyou, Trinities, Trinity Alps, and the Yolla Bollys. We also include the topographically continuous North Coast Ranges of California to the west and to the south of the Klamath Mountains. Lake and Mendocino cos. mark the southern extent of the region; counties farther south lack the montane environments present to Snow Mountain (Heckard and Hickman 1984). Northwestern California is treated by a checklist of the vascular plants (Smith and Sawyer 1987) and by a key to families and genera (Smith and Sawyer 1981).

The traditional explanation for the area's rich flora is that it is a mixture of California and northern plants. It is not surprising that plants from the north and from the south occur here. The area is geographically and environmentally central on the West Coast of North America (Whittaker 1961), and geologically complicated, with its many disjunct areas of ultramafic rock (Whittaker 1960, Sawyer and Thornburgh 1977, Kruckeberg 1984). In addition, the ancient terrain supports great habitat variety in a moderated, maritime climate (Richerson and Lum 1980). The area, especially the Klamath Mountains, is viewed as a refugium of Tertiary plants (Wolfe 1969, Axelrod 1976).

TYPES OF ENDEMISM

The relictual nature of the flora is seen in many families and genera, although not all of them appear in the list of endemic taxa because they also occur outside of the region. *Aruncus dioicus*, *Calypto bulbosa*, *Darlingtonia californica*, *Disporum hookeri*, *Euonymus occidentalis*, *Mahonia nervosa*, *Polystichum munitum*, *Sequoia sempervirens*, and *Trautvetteria carolinensis* are typical of the many "Arcto-Tertiary" plants that grow in the Klamath Mountains or along the coast at lower elevations.

In addition, the flora is seen as being enriched by plants of Mexican origin, such as *Arbutus*, *Garrya*, and *Gaultheria* that now grow with *Sequoia* in the redwood forest (Abrams 1925, Axelrod 1977). Many of these southern elements grow in the woodlands, chaparral, and grasslands found at lower elevations or near the coast. The events of the Pleistocene and hypsithermal are also seen as causing further accumulations of various plants from the north, such as *Empetrum nigrum* and *Menyanthes trifoliata*; of *Purshia tridentata* and *Forsselia stipulifera* from the Great Basin; and of *Pinus sabiniana* from central California.

The relictual nature of the flora can also be evaluated by a review of a list of endemics (Appendix 1). Plants without close relatives or

those whose close relatives are disjunct are typically considered paleoendemic or relicts (Stebbins 1980). *Kalmiopsis leachiana*, *Picea breweriana*, *Quercus sadleriana* (Tucker 1983), and *Cornus sessilis* are good examples. But the list contains surprisingly few relicts.

In this geologically stable area, with its moderated climate, we might also expect to find a larger number of endemic species, and perhaps even endemic genera (Kruckeberg and Rabinowitz 1985). Only two monotypic genera, *Bensoniella* and *Tracyina*, are endemic. Others, such as *Cycladenia humilis*, *Darlingtonia californica*, and *Whitneya dealbata*, often thought to be endemic to the region, are not.

To summarize, the centrally positioned, continuous montane environment among the North Coast Ranges, the Klamath Mountains, the Cascades, and the Sierra Nevada accounts for much of the floristic richness, but not for the degree of endemism. Similarly, the invoking of paleoendemism, taken by itself, is not adequate.

ANALYSIS OF THE ENDEMIC FLORA

In surveying the list of endemic taxa, we were impressed by the large number of infraspecific taxa. In this observation lies another explanation for the local level of endemism. Some of the taxa, such as *Iris tenax* subsp. *klamathensis*, *Dicentra formosa* subsp. *oregana*, and *Holodiscus discolor* var. *delnortensis*, represent regional variants of widespread, western species. Others, such as *Juniperus communis* var. *jackii* and *Chlorogalum pomeridianum* var. *minus*, are typical of serpentine substrates. Some plants, as in *Trillium ovatum* subsp. *oettingeri*, grow at higher elevations than do the typical forms of the species. Still others, such as *Monardella odoratissima* subsp. *pallida* and *Penstemon newberryi* subsp. *berryi*, appear to be local expressions of common Sierran species.

To evaluate further the list of endemics, genera with five or more taxa were singled out and appear in Table 1. Many of them, such as *Arabis*, *Penstemon*, or *Lupinus*, are expected, as they are known for their diversity in the western United States. Other large genera, such as *Aster*, *Carex*, *Lotus*, or *Phlox*, are conspicuously absent.

The number of endemic species can be compared to the total taxa in each genus. For example, *Phacelia* is a genus of about 200 species, of which 29 grow in the area, seven of them endemic. A few genera, such as *Arabis*, *Horkelia*, *Lilium*, and *Limnanthes*, stand out as being unusually high in regional endemics. Of all of the taxa tallied, *Lewisia*, *Sedum*, and *Sidalcea* have an exceptionally high number of regional endemics.

Such comparisons might be better judged in a larger geographical context. Table 1 also shows the number of taxa for California (Munz 1959, 1968). A larger number of species and infraspecific taxa would

TABLE 1. GENERA IN NORTHWESTERN CALIFORNIA AND SOUTHWESTERN OREGON WITH FIVE OR MORE ENDEMIC TAXA. The fraction represents the number of species/number of subspecific taxa. Estimates for size in each genus are after Willis (1973); those with "*" are from Raven and Axelrod (1978). Taxa in the region itself are from Peck (1961), Smith and Sawyer (1987), and recent monographs. The values in parentheses are species : taxa ratios. If all taxa are at the species rank, the ratio equals 1.0.

Genus	No. species per genus	Endemics in area	Taxa in area	Taxa in California
I. Large genera, <100 species				
<i>Arabis</i>	120	7/8 (1.1)	21/26 (1.2)	35/52 (1.5)
<i>Epilobium</i>	215	6/6 (1.0)	18/22 (1.2)	36/22 (1.6)
<i>Eriogonum</i>	250	10/11 (1.1)	33/47 (1.4)	104/158 (1.5)
<i>Lupinus</i>	200*	8/9 (1.1)	36/54 (1.5)	82/144 (1.8)
<i>Penstemon</i>	250*	5/5 (1.0)	20/27 (1.4)	49/75 (1.2)
<i>Phacelia</i>	200	7/7 (1.0)	29/31 (1.1)	91/116 (1.3)
<i>Plagiobothrys</i>	100	4/5 (1.2)	17/20 (1.1)	39/50 (1.3)
<i>Sedum</i>	600	5/10 (2.0)	11/20 (1.8)	12/18 (1.5)
II. Moderate-sized genera, 10–80 species				
<i>Arctostaphylos</i>	50*	7/7 (1.0)	16/21 (1.3)	32/53 (1.7)
<i>Calochortus</i>	60	6/6 (1.0)	16/18 (1.1)	39/52 (1.3)
<i>Horkelia</i>	30	4/5 (1.2)	8/10 (1.2)	16/25 (1.6)
<i>Lewisia</i>	20	3/6 (2.0)	8/11 (1.4)	13/18 (1.4)
<i>Lilium</i>	80	5/5 (1.0)	11/12 (1.1)	15/19 (1.3)
<i>Limnanthes</i>	10*	3/5 (1.7)	4/9 (2.3)	7/11 (1.6)
<i>Sidalcea</i>	25	3/7 (2.3)	9/21 (2.3)	18/33 (1.8)

be expected for this larger area. One way to reduce the effect of area is to express the numbers as ratios. *Lupinus*, for example, is a genus of about 200 species. Munz reports 82 species and 144 subspecies and varieties in California. There are, then, almost two infraspecific taxa per species of *Lupinus* in the state.

When northwest California is compared to the state as a whole, a predicted pattern is seen, i.e., the smaller the area, the smaller the ratio. California includes those taxa of the Sierra Nevada, the Cascades, the Klamaths, and the North Coast in the tally, so that the ratio would be larger than that for the northwest section of the state alone. Furthermore, the ratio for endemics would be expected to be even smaller yet, because they are restricted to a smaller area. The expected ratio reduction does occur for most of the genera in Table 1. Exceptions are *Lewisia*, *Sedum*, and *Sidalcea*, where the ratio increases. This is taken as evidence that adaptive radiation is occurring in the region. We conclude, therefore, that northwest California and southwest Oregon is not only a refugium, but it is also an area of active diversification today.

An abundance of local varieties and subspecies is expected as populations adapt to the unique set of environmental controls

(Kruckeberg and Rabinowitz 1985). The region's heterogeneity of topography and parent material offers the setting for this diversification. Stebbins and Major (1965), using Lake Co., California, an area containing volcanic, sedimentary, and ultramafic substrates, argued that under such settings neoendemics would be developed during periods of changing climate. Axelrod (1982) makes a similar argument for the Monterey endemic area. The celebrated patchy matrix of habitats found in northwest California and southwest Oregon supplies a larger stage for the addition of a high number of new taxa into the region's flora during the recent period of climatic change.

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APPENDIX 1. ANNOTATED CATALOGUE OF ENDEMIC VASCULAR PLANTS

County abbreviations: CALIFORNIA. COL = Colusa; DNT = Del Norte; GLE = Glenn; HUM = Humboldt; LAK = Lake; MEN = Mendocino; SHA = Shasta; SIS = Siskiyou; TEH = Tehama; TRI = Trinity. OREGON. COS = Coos; CUR = Curry; DOU = Douglas; JAC = Jackson; JOS = Josephine.

A-1 to A-4 indicates that the plant is listed in Smith and York (1984).

- A-1 = Plants of highest priority
- A-2 = Plants rare or endangered in California, but more common elsewhere
- A-3 = Plants about which we need more information
- A-4 = Plants of limited distribution

B-1 to B-3 indicates that the plant is listed in Siddall et al. (1979).

- B-1a = Very local endemic
- B-1b = Regional endemic
- B-2a = Plants thinly scattered over a wide range
- B-2b = Known only from a few widely disjunct populations
- B-3 = Of concern in Oregon, more abundant elsewhere

C indicates that the plant is listed in Meinke (1981).

D-1 to D-3 indicates that the plant is listed in Soper et al. (1985).

- D-1 = Taxa endangered or threatened throughout range, including those possibly extinct
- D-2 = Taxa endangered or threatened in Oregon, but more common or stable elsewhere
- D-3 = Taxa limited in abundance throughout range, but currently stable

PINOPHYTA

Cupressaceae

Juniperus communis Linnaeus var. *jackii* Rehder. DNT, SIS; CUR.

Pinaceae

Picea breweriana Watson. DNT, HUM, TRI, SIS; COS, CUR, JAC, JOS.

MAGNOLIOPHYTA: MAGNOLIOPSIDA

Berberidaceae

Mahonia nervosa (Pursh) Nuttall var. *mendocinensis* (Roof) Roof. MEN; A-3.
Vancouveria chrysantha Greene. DNT, SIS; CUR, JOS; A-4, B-1b.

Boraginaceae

Cryptantha clevelandii Greene var. *dissita* (I. M. Johnston) Jepson & Hoover. LAK.
Cryptantha crinita Greene. SHA, TEH; A-1.
Hackelia amethystina J. T. Howell. GLE, LAK, MEN, TEH, TRI; A-4.
Hackelia bella (Macbride) I. M. Johnston. HUM, MEN, SIS, TEH, TRI.
Plagiobothrys hirtus (Greene) I. M. Johnston var. *corallicarpa* (Piper) I. M. Johnston.
JAC, JOS; B-1b, C, D-1.
Plagiobothrys hirtus (Greene) I. M. Johnston var. *hirtus*. DOU; B-1b, C.
Plagiobothrys lamprocarpus (Piper) I. M. Johnston. JOS; B-1a, C, D-1.
Plagiobothrys lithocaryus (Greene ex A. Gray) I. M. Johnston. LAK, MEN; A-4.
Plagiobothrys tener (Greene) I. M. Johnston var. *subglaber* I. M. Johnston. LAK.

Campanulaceae

Campanula shetleri Heckard. SHA, SIS; A-1.

Caryophyllaceae

- Minuartia decumbens* T. W. & J. P. Nelson. SHA, TEH, TRI; A-1.
Minuartia howellii (Watson) Mattfeld. DNT; CUR, JOS; A-4.
Minuartia nuttallii (Pax) Briquet subsp. *gregaria* (Heller) Maguire. COL, HUM, LAK, MEN, SIS, TEH, TRI; CUR, JAC, JOS.
Minuartia rosei (Maguire & Barneby) McNeill. SHA, TEH, TRI; A-4.
Silene campanulata Watson subsp. *campanulata*. MEN; A-1.
Silene hookeri Nuttall ex Torrey & A. Gray subsp. *bolanderi* (A. Gray) Abrams. HUM, MEN, TRI; CUR, JOS; B-3, D-2.
Silene hookeri Nuttall ex Torrey & A. Gray subsp. *pulverulenta* (Peck) Hitchcock & Maguire. JAC, JOS; B-1b.
Silene marmorensis Kruckeberg. SIS; A-1.

Compositae

- Antennaria suffrutescens* Greene. DNT, HUM; CUR, JOS; A-4.
Arnica cernua T. J. Howell. DNT, HUM, SIS, SHA, TRI; COS, CUR, JOS; A-4.
Arnica spathulata Greene subsp. *eastwoodiae* (Rydberg) Ediger & Barkley. DNT, HUM, SIS; CUR, DOU, JAC, JOS; A-4.
Arnica venosa Hall. SHA, TRI; A-4.
Aster brickelliioides Greene var. *brickelliioides*. DNT, SIS; CUR, JAC, JOS; A-4.
Aster siskiyouense Nelson & Macbride. GLE, SIS, TEH, TRI; JAC, JOS.
Balsamorhiza sericea Weber. TRI, SIS; JOS; A-4, B-1b, C, D-1.
Chaenactis suffrutescens A. Gray. SIS, TRI; A-4.
Cirsium acanthodontum Blake. DNT, HUM; COS, CUR, DOU.
Cirsium ciliolatum (Henderson) J. T. Howell. SIS; JAC; A-1, B-1b, D-3.
Erigeron bloomeri A. Gray var. *nudatus* (A. Gray) Cronquist. DNT, SIS; JAC, JOS; A-2.
Erigeron bloomeri A. Gray var. *pubens* Keck. SIS, TEH, TRI.
Erigeron delicatus Cronquist. DNT; CUR, JOS; A-3, B-1b, C.
Erigeron flexuosus Cronquist. DNT, SHA, TRI; A-1.
Eriophyllum lanatum (Pursh) Forbes var. *aphanactis* J. T. Howell. GLE, COL, LAK.
Eriophyllum lanatum var. *lanceolatum* (T. J. Howell) Jepson. DNT, HUM, SIS, TEH, TRI; CUR, JAC, JOS.
Eupatorium shastense Taylor & Stebbins. SHA; A-4.
Grindelia stricta De Candolle subsp. *blakei* (Steyermark) Keck. HUM; A-1.
Haplopappus ophitidis (J. T. Howell) Keck. SHA, TEH, TRI; A-4.
Haplopappus racemosus (Nuttall) Torrey subsp. *congestus* (Greene) Hall. DNT; CUR, DOU, JAC, JOS; A-4, C.
Haplopappus racemosus subsp. *pinetorum* Keck. SIS, TRI.
Hazardia whitneyi (A. Gray) Greene var. *discoideus* (J. T. Howell) D. Clark. GLE, HUM, LAK, SIS, TRI; DOU, JOS; B-3, D-2.
Helianthella californica A. Gray var. *shastensis* W. Weber. SHA, SIS, TRI.
Hemizonia calyculata (Babcock & Hall) Keck. LAK, MEN; A-4.
Hemizonia tracyi (Babcock & Hall) Keck. HUM, MEN, TRI; A-4.
Heterotheca breweri (A. Gray) Shinnery var. *multibracteata* Jepson. SIS, TEH, TRI.
Lasthenia macrantha (A. Gray) Greene subsp. *prisca* Ornduff. CUR; B-1b, C, D-3.
Madia doris-nilesiae T. W. Nelson & J. P. Nelson. TRI.
Madia gracilis (Small) Keck subsp. *pilosa* Keck. HUM.
Madia stebbinsii T. W. & J. P. Nelson. TEH, TRI; A-1.
Microseris detlingii Chambers. JAC; B-1a, C.
Microseris howellii A. Gray. DNT; CUR, JAC, JOS; B-1b, C, D-1.
Microseris laciniata (Hooker) Schulz-Bipontinus subsp. *siskiyouensis* Chambers. DNT, HUM, SIS; CUR, JOS.
Raillardella pringlei Greene. SIS, TRI; A-1.
Rudbeckia californica A. Gray var. *glauca* Blake. DNT, TRI; CUR, DOU, JOS.

- Rudbeckia californica* A. Gray var. *intermedia* Perdue. SIS, TRI.
Senecio greenei A. Gray. GLE, LAK, MEN, TRI.
Senecio hesperius Greene. CUR, JOS; B-1b, C, D-1.
Tracyina rostrata Blake. HUM, LAK; A-1.
Wyethia longicaulis A. Gray. HUM, MEN, TRI; A-4.

Convolvulaceae

- Calystegia collina* (Greene) Brummitt subsp. *tridactylosa* (Eastwood) Brummitt. MEN.

Crassulaceae

- Parvisedum leiocarpum* (H. K. Sharsmith) Clausen. LAK; A-1.
Sedum laxum (Britton) Berger subsp. *eastwoodiae* (Britton) Clausen. MEN; A-1.
Sedum laxum (Britton) Berger subsp. *flavidum* Denton. DNT, HUM, SIS, TRI; A-1.
Sedum laxum (Britton) Berger subsp. *heckneri* (Peck) Clausen. DNT, HUM, SIS, TRI; CUR, JAC, JOS; A-4, D-3.
Sedum laxum (Britton) Berger subsp. *latifolium* Clausen. DNT.
Sedum laxum (Britton) Berger subsp. *laxum*. DNT, SIS; CUR, JAC, JOS.
Sedum moranii Clausen. JOS; C, D-1.
Sedum oblanceolatum Clausen. SIS; JAC; C.
Sedum obtusatum A. Gray subsp. *paradisum* Denton. SHA, TRI; A-1.
Sedum obtusatum A. Gray subsp. *retusum* (Rose) Clausen. LAK, MEN, SIS, TRI; CUR, JAC.
Sedum radiatum Watson subsp. *depauperatum* Clausen. SIS; JOS; A-3.

Cruciferae

- Arabis aculeolata* Greene. DNT, SIS; CUR, JOS; A-1, C.
Arabis koehleri T. J. Howell var. *koehleri*. DOU, JOS; B-1b, C, D-1.
Arabis koehleri T. J. Howell var. *stipitata* Rollins. CUR, JOS; C, D-3.
Arabis macdonaldiana Eastwood. DNT, MEN; CUR, JOS; A-2, C, D-1.
Arabis oregona Rollins. MEN, SIS, TRI; JAC, JOS; A-3.
Arabis rigidissima Rollins. HUM, SIS, TRI; A-4.
Arabis serpentinicola Rollins. SIS; CUR; A-1, B-1b, C.
Arabis subpinnatifida Watson. GLE, HUM, MEN, SIS; DOU, JAC, JOS.
Cardamine gemmata Greene. DNT, SIS; CUR, JAC, JOS; A-1, B-1b, D-2.
Draba carnosula O. E. Schulz. SIS, TRI; A-1.
Draba howellii Watson. DNT, HUM, SHA, SIS, TRI; JOS; A-4, B-1b, D-1.
Draba pterosperma Payson. SIS; A-4.
Streptanthus barbatus Watson. SIS, TEH, TRI.
Streptanthus howellii Watson. DNT; CUR, JOS; A-2, B-1b, C, D-1.
Streptanthus tortuosus Keller var. *pallidus* Jepson. HUM, SIS, TRI.
Thlaspi montanum Linnaeus var. *californicum* (Watson) P. Holmgren. HUM; A-1.
Thlaspi montanum Linnaeus var. *siskiyouense* P. Holmgren. CUR, JOS; C, D-3.

Cuscutaceae

- Cuscuta salina* Engelmann var. *papillata* Yuncken. MEN.

Ericaceae

- Arctostaphylos* × *cinerea* T. J. Howell. DNT; CUR, DOU, JOS.
Arctostaphylos hispidula T. J. Howell. DNT, HUM; CUR, JOS; A-4, B-1b, C, D-3.
Arctostaphylos klamathensis Edwards, Keeler-Wolf, & Knight. SIS; A-1.
Arctostaphylos knightii Gankin & Hildreth. DNT, HUM.
Arctostaphylos manzanita Parry subsp. *roofii* (Gankin) P. V. Wells. LAK, TEH.

Arctostaphylos stanfordiana Parry subsp. *raichei* Knight. LAK, MEN.
Arctostaphylos tracyi Eastwood. DNT, HUM, MEN.
Kalmiopsis leachiana (Henderson) Rehder. CUR, DOU, JOS; C.
Rhododendron occidentale (Torrey & A. Gray) var. *paludosum* Jepson. HUM, DNT.

Euphorbiaceae

Chamaesyce ocellata (Durand & Hilgard) Millsbaugh var. *rattanii* (Watson) Koutnik.
GLE, TEH; A-4.

Fagaceae

Quercus garryana Douglas var. *breweri* (Engelmann in Watson) Jepson. LAK, HUM,
MEN, SIS, TRI; CUR, JAC, JOS.
Quercus sadleriana R. Brown of Campster. DNT, SIS, TEH; COS, CUR, DOU, JAC,
JOS.

Fumariaceae

Dicentra formosa (Haworth) Walpers subsp. *oregana* (Eastwood) Munz. DNT, HUM,
SIS, TRI; CUR, JOS; A-4, B-1b, C.

Garryaceae

Garrya buxifolia A. Gray. DNT, HUM, MEN, SIS; CUR, JOS.

Gentianaceae

Gentiana bisetacea T. J. Howell. CUR, JOS; C, D-1.
Gentiana setigera A. Gray. HUM, MEN, SIS, TRI; JAC, JOS; A-3.

Grossulariaceae

Ribes inerme Rydberg var. *subarmatum* Peck. JAC.
Ribes marshallii Greene. HUM, SIS; JAC, JOS; A-4, B-3, D-2.

Hydrophyllaceae

Phacelia argentea Nelson & Macbride. DNT; COS, CUR; A-1, B-1b, C, D-1.
Phacelia capitata Kruckeberg. COS, DOU, JAC; B-1b, C.
Phacelia cookei Constance & Heckard. SIS; A-1.
Phacelia dalesiana J. T. Howell. SIS, TRI; A-1.
Phacelia greenei J. T. Howell. SIS, TRI; A-1.
Phacelia leonis J. T. Howell. SIS, TRI; JOS; A-3, B-1b, D-2.
Phacelia pringlei A. Gray. SIS, TRI; JAC; A-1.

Labiatae

Monardella purpurea T. J. Howell. DNT, HUM, SIS; CUR, JOS; A-4, B-1b, D-2.
Stachys rigida Nuttall ex Benthham subsp. *lanata* Epling. DNT, HUM.

Leguminosae

Astragalus agnicidus Barneby. HUM; A-1.
Astragalus rattanii A. Gray var. *rattanii*. COL, HUM, MEN, LAK, TRI.
Lathyrus biflorus T. W. Nelson & J. P. Nelson. HUM; A-1.
Lathyrus delnorticus C. L. Hitchcock. DNT; COS, CUR, JOS; A-4, B-1b, D-2.
Lathyrus glandulosus Broich. HUM, MEN.
Lathyrus sulfureus Brewer ex A. Gray var. *argillaceus* Jepson. SHA, TEH.
Lathyrus tracyi Bradshaw. GLE, MEN, SIS, TRI.

- Lotus yollabolliensis* Munz. HUM, TRI; A-4.
Lupinus antoninus Eastwood. MEN, TEH, TRI; A-1.
Lupinus aridus Douglas ex Lindley subsp. *ashlandensis* Cox. JAC; B-1a, C, D-1.
Lupinus constancei T. W. Nelson & J. P. Nelson. HUM, TRI; A-1.
Lupinus croceus Eastwood var. *croceus*. SIS, TRI.
Lupinus croceus Eastwood var. *pilosellus* (Eastwood) Munz. SHA, SIS, TRI; A-4.
Lupinus lapidicola Heller. DNT, SIS; A-4.
Lupinus milo-bakeri C. P. Smith. MEN; A-1.
Lupinus mucronulatus T. J. Howell var. *mucronulatus*. JOS; B-1b.
Lupinus tracyi Eastwood. DNT, HUM, SIS, TRI; JOS; A-4, B-2b, C, D-2.
Sophora leachiana Peck. CUR, JOS; B-1b, C, D-3.
Trifolium longipes Nuttall subsp. *oreganum* (T. J. Howell) J. Gillett. HUM, SHA, TRI; JOS.
Trifolium longipes Nuttall subsp. *shastense* (House) J. Gillett. DNT, SHA, SIS.

Limnanthaceae

- Limnanthes bakeri* T. J. Howell. MEN; A-1.
Limnanthes floccosa T. J. Howell subsp. *bellingeriana* (Peck) Arroyo. SHA; JAC; A-1, B-2b, C, D-1.
Limnanthes floccosa T. J. Howell subsp. *grandiflora* Arroyo. JAC; B-1a, C, D-1.
Limnanthes floccosa T. J. Howell subsp. *pumila* (T. J. Howell) Arroyo. JAC; B-1a, C, D-1.
Limnanthes gracilis T. J. Howell var. *gracilis*. DOU, JAC, JOS; B-1b, C, D-1.

Linaceae

- Hesperolinon adenophyllum* (A. Gray) Small. HUM, LAK, MEN; A-4.
Hesperolinon tehamense H. K. Sharsmith. GLE, TEH.

Malvaceae

- Malacothamnus mendocinensis* (Eastwood) Kearney. MEN; A-1.
Sidalcea malvaeflora (De Candolle) A. Gray ex Benth. subsp. *celata* (Jepson) C. L. Hitchcock. SHA, SIS, TRI.
Sidalcea malvaeflora (De Candolle) A. Gray ex Benth. subsp. *elegans* (Greene) C. L. Hitchcock. DNT, SIS; CUR, JAC, JOS; A-4.
Sidalcea malvaeflora (De Candolle) A. Gray ex Benth. subsp. *nana* (Jepson) C. L. Hitchcock. SIS, TEH; JAC, JOS.
Sidalcea malvaeflora (De Candolle) A. Gray ex Benth. subsp. *patula* C. L. Hitchcock. CUR; B-1b, D-2.
Sidalcea oregana (Nuttall ex Torrey & A. Gray) A. Gray subsp. *eximia* (Greene) C. L. Hitchcock. HUM, MEN, SIS, TRI; CUR, JAC, JOS.
Sidalcea setosa C. L. Hitchcock subsp. *querceta* C. L. Hitchcock. CUR; B-1a, D-1.
Sidalcea setosa C. L. Hitchcock subsp. *setosa*. SIS; CUR, DOU, JAC, JOS; A-4, C, D-3.

Nyctaginaceae

- Mirabilis greenei* Watson. COL, GLE, SHA, SIS, TEH; JAC; D-2.

Onagraceae

- Clarkia amoena* (Lehmann) Nelson & Macbride subsp. *whitneyi* (A. Gray) Lewis & Lewis. HUM, MEN; A-4.
Clarkia borealis E. Small subsp. *borealis*. SHA, TRI; A-4.
Epilobium canum (Greene) Raven subsp. *septentrionale* (Keck) Raven. HUM, MEN, TRI; A-4.

- Epilobium nivium* Brandege. COL, GLE, LAK, MEN, TRI; A-1.
Epilobium oreganum Greene. DNT, HUM, SIS, TEH, TRI; DOU, JOS; A-4, B-1b, C, D-1.
Epilobium rigidum Haussknecht. DNT, SIS; CUR, JAC, JOS; A-4, B-1b, D-2.
Epilobium siskiyouense (Munz) Hoch & Raven. SIS, TRI; JAC; A-1, C, D-2.

Polemoniaceae

- Eriastrum brandegeae* Mason. COL, GLE, LAK; A-1.
Linanthus harknesii (Curran) Greene subsp. *condensatus* Mason. GLE; A-1.
Linanthus nuttallii Milliken subsp. *howellii* Nelson & Patterson. TEH.
Linanthus rattanii (A. Gray) Greene. COL, GLE, LAK, MEN, TEH; A-4.
Navarretia pauciflora Mason. LAK; A-1.
Phlox azurea G. L. Smith. MEN.
Phlox hirsuta E. Nelson. SIS; A-1.

Polygonaceae

- Chorizanthe howellii* Goodman. MEN; A-1.
Eriogonum alpinum Engelm. SIS, TRI; A-1.
Eriogonum congdonii (S. Stokes) Reveal. SHA, SIS, TRI; A-4.
Eriogonum diclinum Reveal. SIS; JOS; A-4, B-1b, D-2.
Eriogonum hirtellum J. T. Howell & Bacigalupi. DNT, SIS; A-4.
Eriogonum kelloggii A. Gray. MEN; A-1.
Eriogonum libertini Reveal. SHA, TEH, TRI; A-4.
Eriogonum pendulum Watson. DNT; CUR, JOS; A-2, B-1b, C.
Eriogonum siskiyouense Small. SIS, TRI; A-4.
Eriogonum ternatum T. J. Howell. DNT, SIS, TEH; CUR, JOS; A-4, D-3.
Eriogonum umbellatum Torrey var. *speciosum* (Drew) S. Stokes. DNT, SIS.

Portulacaceae

- Claytonia saxosa* Brandege. HUM, LAK, MEN, SIS.
Lewisia cotyledon (Watson) Robinson in A. Gray subsp. *cotyledon*. DNT, SIS, TRI; JAC, JOS.
Lewisia cotyledon (Watson) Robinson in A. Gray subsp. *heckneri* (Morton) Munz. SIS, TRI; A-1.
Lewisia cotyledon (Watson) Robinson in A. Gray var. *howellii* (Watson) Jepson. DNT, HUM, SIS, TRI; CUR, DOU, JAC, JOS; A-3, C.
Lewisia cotyledon (Watson) Robinson in A. Gray var. *purdyi* Jepson. CUR, JOS; C, D-1.
Lewisia oppositifolia (Watson) Robinson in A. Gray. DNT; CUR, JAC, JOS; A-1, B-1b, C, D-2.
Lewisia stebbinsii Gankin & Hildreth. MEN, TRI; A-1.

Ranunculaceae

- Delphinium decorum* Fischer & Meyer subsp. *tracyi* Ewan. COL, GLE, HUM, MEN, LAK, TEH, TRI; CUR, JAC, JOS.
Ranunculus austro-oreganus Benson. JAC; C, D-3.

Rhamnaceae

- Ceanothus pumilus* Greene. DNT, HUM, MEN, SIS, TRI; CUR, JAC, JOS.

Rosaceae

- Holodiscus discolor* (Pursh) Maximowicz var. *delnortensis* Ley. DNT, SIS, TRI; JOS.
Horkelia bolanderi A. Gray subsp. *bolanderi*. COL, LAK.

- Horkelia daucifolia* (Greene) Rydberg subsp. *daucifolia*. SIS, TEH, TRI; JAC.
Horkelia daucifolia (Greene) Rydberg subsp. *latior* Keck. TRI.
Horkelia hendersonii T. J. Howell. JAC; B-1b, C, D-1.
Horkelia sericata Watson. DNT, HUM; CUR, JOS; A-2.
Ivesia pickeringii Torrey ex A. Gray. SIS, TRI; A-1.
Potentilla glandulosa Lindley subsp. *globosa* Keck. DNT, HUM, SIS; CUR, JAC, JOS; D-2.
Rubus leucodermis Douglas ex Torrey & A. Gray var. *trinitatis* Berger. TRI.

Rubiaceae

- Galium ambiguum* Wight var. *siskiyouense* Ferris. DNT, HUM, MEN, SIS, TRI; CUR, DOU, JOS.
Galium glabrescens (Ehrendorfer) Dempster & Ehrendorfer subsp. *glabrescens*. DNT, SIS, TRI.
Galium glabrescens (Ehrendorfer) Dempster & Ehrendorfer subsp. *josephinense* Dempster & Ehrendorfer. JOS.
Galium serpenticum Dempster subsp. *scotticum* Dempster & Ehrendorfer. SIS, TRI; A-1.

Salicaceae

- Salix delnorticus* C. K. Schneider. DNT; JOS; A-4, B-1b, D-2.
Salix tracyi Ball. DNT, HUM; CUR, JAC, JOS; A-4, B-1b, D-2.

Saxifragaceae

- Bensoniella oregona* (Abrams & Bacigalupi) Morton. HUM; CUR, DOU, JOS; A-1, C, D-3.
Heuchera pringlei Rydberg. DNT, SIS.
Saxifraga fragarioides Greene. DNT, HUM, SIS, TRI; CUR, JAC, JOS.

Scrophulariaceae

- Antirrhinum subcordatum* A. Gray. COL, GLE, LAK, TEH; A-4.
Castilleja brevilobata Piper. DNT, SIS; JOS; A-4.
Castilleja elata Piper. DNT, SIS; CUR, JOS; A-2.
Castilleja mendocinensis (Eastwood) Pennell. MEN; A-1.
Castilleja schizotricha Greenman. SIS; JAC; A-4.
Collinsia linearis A. Gray. DNT, HUM, SIS, TRI; JAC, JOS.
Cordylanthus tenuis A. Gray subsp. *pallescent* (Pennell) Chuang & Heckard. SIS; A-1.
Mimulus brachiatus Pennell. LAK; A-3.
Mimulus primuloides Benth. var. *linearifolius* Grant. SHA, SIS, TRI.
Orthocarpus castillejoideus Benth. var. *humboldtensis* Keck. HUM; A-1.
Orthocarpus erianthus Benth. var. *gratiosus* Jepson & Tracy. DNT, HUM, MEN; CUR, JOS.
Orthocarpus pachystachys A. Gray. SIS; A-1.
Pedicularis howellii A. Gray. SIS; JOS; A-4, B-1b, C, D-3.
Penstemon anguineus Eastwood. DNT, GLE, HUM, MEN, SIS, TRI; CUR, DOU, JAC, JOS.
Penstemon filiformis (Keck) Keck. SHA, TRI; A-1.
Penstemon newberryi A. Gray subsp. *berrysii* (Eastwood) Keck. DNT, GLE, HUM, SIS, TRI; CUR, JOS.
Penstemon purpusii Brandegee. COL, GLE, HUM, LAK, MEN, TEH, TRI; A-4.
Penstemon tracyi Keck. SIS, TRI; A-1.
Synthyris missurica (Rafinesque) Pennell subsp. *hirsuta* Pennell. DOU; B-1a, C, D-1.
Veronica copelandii Eastwood. SIS, TRI; A-4.

Umbelliferae

- Eryngium constancei* Sheikh. LAK; A-1.
Ligusticum californicum Coulter & Rose. DNT, GLE, HUM, MEN, SIS, TRI.
Lomatium cookii J. S. Kagan. JAC.
Lomatium engelmannii Mathias. MEN, SIS, TRI; CUR, JOS; A-4, B-1b, D-2.
Lomatium howellii (Watson) Jepson. DNT, SIS; CUR, JOS; A-4, B-1b.
Lomatium tracyi Mathias & Constance. HUM, SHA, SIS, TEH, TRI; A-4, B-1b, D-2.
Perideridia leptocarpa Chuang & Constance. SIS; A-4.
Sanicula peckiana Macbride. DNT; CUR, JOS; A-4.
Sanicula tracyi Shan & Constance. HUM, TEH, TRI; JOS; A-1, B-1b, C.
Tauschia glauca (Coulter & Rose) Mathias & Constance. DNT, HUM, TRI; CUR, DOU, JAC, JOS; A-4.
Tauschia howellii (Coulter & Rose) Macbride. SIS; CUR, JAC; A-1, B-1b, C, D-1.

Violaceae

- Viola lanceolata* Linnaeus subsp. *occidentalis* (A. Gray) Russell. DNT; CUR, DOU, JOS; A-1, B-1b, C, D-2.
Viola macloskeyi Lloyd subsp. *pallens* (Banks ex De Candolle) M. S. Baker. SIS.

MAGNOLIOPHYTA: LILIOPSIDA

Gramineae

- Calamagrostis foliosa* Kearney. DNT, HUM, MEN; A-1.
Lophochlaena californicus Nees var. *davyi* (L. Benson) Löve. LAK, MEN.
Poa piperi Hitchcock. DNT, SIS; CUR, JOS; A-4, B-1b, C, D-2.

Iridaceae

- Iris bracteata* Watson. DNT; CUR, JOS; A-2.
Iris innominata Henderson. DNT; COS, CUR, DOU, JOS; A-2.
Iris tenax Douglas subsp. *klamathensis* Lenz. HUM, SIS; A-4.

Liliaceae

- Allium fimbriatum* Watson var. *purdyi* (Eastwood) Ownbey & Aase. COL, LAK; A-4.
Allium hoffmanii Ownbey. HUM, SHA, TEH, TRI; A-4.
Allium mirabile Henderson. DOU.
Allium siskiyouense Ownbey. DNT, HUM, SIS, TRI; CUR, DOU, JAC, JOS; A-4.
Brodiaea coronaria (Salisbury) Engler subsp. *rosea* (Greene) Niehaus. LAK, TEH; A-1.
Calochortus greenii Watson. SHA, SIS; JAC; A-1, B-1b, C, D-1.
Calochortus howellii Watson. DOU, JOS; C, D-1.
Calochortus indecorus Ownbey & Peck. JOS; C, D-1.
Calochortus monanthus Ownbey. SIS; A-1.
Calochortus nudus Watson var. *shastensis* (Purdy) Jepson. SIS; A-3.
Calochortus persistens Ownbey. SIS; A-1.
Camassia howellii Watson. CUR, JAC, JOS.
Chlorogalum pomeridianum (De Candolle) Kunth var. *minus* Hoover. TEH.
Dichelostemma ida-maia (Wood) Greene. DNT, HUM, LAK, MEN, SHA, TRI; CUR, DOU, JOS.
Dichelostemma venustum (Greene) Hoover. DNT, HUM, MEN, SHA, SIS, TRI; DOU; A-4.
Disporum parvifolium (Watson) Britton. DNT; CUR, JOS.
Erythronium citrinum Watson. DNT, SIS; CUR, JOS; A-4, B-1b.

- Erythronium hendersonii* Watson. DNT, SIS; JAC, JOS; A-3.
Erythronium howellii Watson. DNT; CUR, JOS; A-4, B-1b, D-2.
Fritillaria adamantina Peck. DOU, JAC; B-1b.
Fritillaria gentneri Gilkey. JAC, JOS; B-1b, C, D-1.
Fritillaria glauca Greene. DNT, GLE, HUM, LAK, TRI; CUR, DOU, JAC, JOS; D-2.
Hastingsia atropurpurea Becking. JOS.
Hastingsia bracteosa Watson. JOS; B-1b, C, D-1.
Lilium bolanderi Watson. DNT, HUM, MEN, SIS; CUR, JAC, JOS; A-4, B-1b.
Lilium kelloggii Purdy. DNT, HUM; JOS.
Lilium occidentale Purdy. HUM; COS, CUR; A-1, B-1b, C, D-1.
Lilium vollmeri Eastwood. DNT, HUM, SIS; CUR, JAC, JOS; A-3, C.
Lilium wigginsii Beane & Vollmer. DNT, SIS; JAC; A-3, B-1b, C.
Trillium ovatum Pursh subsp. *oettingeri* Munz & Thorne. SHA, SIS, TRI; A-4.
Trillium rivale Watson. DNT, SIS; CUR, DOU, JOS; A-4.
Triteleia crocea Greene var. *crocea*. DNT, SHA, SIS, TRI; CUR, JAC, JOS; A-4.
Triteleia crocea Greene var. *modesta* (Hall) Hoover. SHA, SIS, TRI; A-4.
Triteleia hendersonii Greene var. *leachiae* (Peck) Hoover. CUR; D-2.

Smilacaceae

- Smilax jamesii* Wallace. DNT, SHA, SIS, TRI; A-4.

ANNOUNCEMENT

NEW PUBLICATION

WALTERS, D. R. and D. J. KEIL. 1988. *Vascular plant taxonomy*, 3rd ed., Kendall/Hunt Publishing Co., Dubuque, Iowa, 1988, 488 pp., illus., ISBN 0-8403-4614-X, \$39.95 (paperbound). [Text for introductory level taxonomy classes, completely rewritten and expanded from 2nd edition. Organized in four sections: Part I, Basics of Introductory Taxonomy, includes nomenclature, vegetative terminology, key construction, introduction to manuals and floras, and plant collecting. Part II, Survey of Vascular Plant Families, includes chapters on ferns and fern allies, gymnosperms, and eleven chapters on angiosperms organized according to Cronquist's 1981 system of classification. Families receiving greatest emphasis are illustrated with original line drawings, floral diagrams, and floral formulas. Part III, Approaches to Classification, briefly surveys character variation, artificial and phenetic systems, traditional phylogenetic systems, and cladistics. Part IV, Gathering and Analysis of Data, examines experimental taxonomy and the preparation of revisions and monographs. The book includes a key to many but not all plant families and a detailed glossary.]